

**T 255 / T 265 TOTAL EVAPORABLE MOISTURE CONTENT OF AGGREGATE BY DRYING
AND LABORATORY DETERMINATION OF MOISTURE CONTENT OF SOILS**

1. Which of the following statements regarding minimum sample mass is true?
 - a. Aggregate sample mass is based on Maximum Particle Size. Soil sample mass is based on Nominal Maximum Size.
 - b. The required mass for any aggregate sample is always larger than soil sample mass regardless of the actual particle size present in either of the materials.
 - c. Aggregate sample mass is based on Nominal Maximum Size. Soil sample mass is based on Maximum Particle Size.
 - d. None of the above. Any convenient sample mass may be used for either aggregate or soil provided that mass determination is made to at least the nearest 0.1 gram.

2. When determining moisture content according to this FOP, samples must be dried to a constant mass. Constant mass for aggregate has been reached when _____; constant mass for soil has been achieved when _____.
 - a. **Aggregate** - - there is no change in mass after 1 hour of additional drying in an oven at a temperature of $230 \pm 9^\circ \text{F}$.
Soil - - there is less than 0.1% change in mass after some additional period of drying (depending on heat source used).
 - b. **Aggregate** - - there is not more than 0.1 percent change in mass after thirty minutes of additional drying in an oven at a temperature of $230 \pm 9^\circ \text{F}$.
Soil - - there is no change in mass after one hour of additional drying in an oven at a temperature of $230 \pm 9^\circ \text{F}$.
 - c. **Aggregate** - - there is less than 0.1% change in mass after some additional period of drying (depending on heat source used).
Soil - - there is no change in mass after one hour of additional drying in an oven at a temperature of $230 \pm 9^\circ \text{F}$.
 - d. There is less than 0.1% change in mass for either aggregate or soil.

3. Given the following masses for a sample of material, what is the change in moisture content, calculated to the nearest 0.01 percent? Has the sample achieved constant mass as determined for aggregate (Yes/No)?

$$\frac{M_P - M_N}{M_P} \times 100$$

Empty container mass	648.6 g
Mass after first drying cycle (container + sample)	4143.4 g
Mass after second drying cycle (container + sample)	4139.5 g

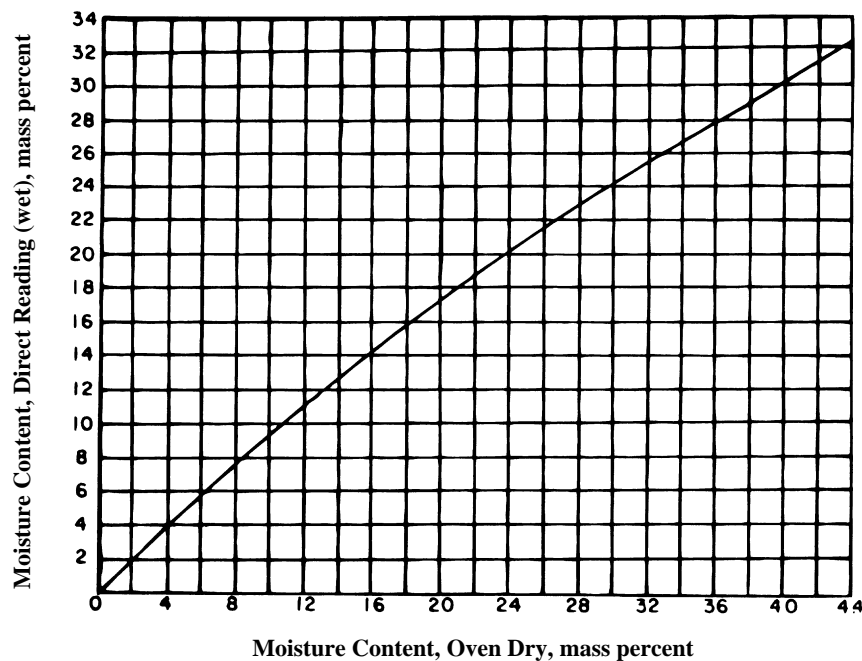
- a. 0.11 - - No
- b. 0.09 - - Yes
- c. 0.11 - - Yes
- d. 0.09 - - No
- e. None of the above.

T 217 DETERMINATION OF MOISTURE IN SOILS BY MEANS OF CALCIUM CARBIDE GAS PRESSURE MOISTURE TESTER

4. Describe the shaking and resting cycles for this test method.

5. After placing the required soil sample in the tester cap, what must be done?
- Turn the tester to a vertical position allowing the soil to contact the reagent. Shake the tester horizontally using a rotating motion to prevent contact of the steel spheres with the gauge or cap. Continue shaking for sixty seconds followed by a thirty-minute rest period to allow the gauge needle to stabilize. Record gauge reading as the moisture content based on the moist sample mass. Consult the appropriate conversion table or chart to determine moisture content based on dry sample mass. Report to the nearest whole percent.
 - Seal the tester by tightening the clamp, thus securing the cap. Begin shaking the tester horizontally using a side-to-side motion, allowing the soil to enter the pressure vessel. Continue for the number of shaking and resting cycles required by the FOP. Wait for the gauge needle to stabilize and record as the moisture content based on moist sample mass. Consult the appropriate conversion table or chart to determine moisture content based on dry sample mass. Estimate and report moisture content to the nearest 0.1 percent.
 - Seal the tester by tightening the clamp, thus securing the cap. Turn the tester to a vertical position, allowing the soil to fall from the cap into the pressure vessel. Begin shaking the tester horizontally using a rotating motion to prevent contact of the steel spheres with the gauge or cap. Continue for the number of shaking and resting cycles required by the FOP. After the gauge needle stabilizes, read and report as the moisture content to the nearest whole percent.
 - Seal the tester by tightening the clamp, thus securing the cap. Turn the tester to a vertical position, allowing the soil to fall from the cap into the pressure vessel. Begin shaking the tester horizontally using a rotating motion to prevent contact of the steel spheres with the gauge or cap. Continue for the number of shaking and resting cycles required by the FOP. After the gauge needle stabilizes, read and record as the moisture content based on moist sample mass. Consult the appropriate conversion table or chart to determine moisture content based on dry sample mass. Estimate and report moisture content to the nearest whole percent.
 - None of the above.

6. Using the chart provided below, a direct-reading moisture content of 19 percent is approximately equal to what reported dry moisture content?
- a. 21.3 percent
 - b. 21 percent
 - c. 22.5 percent
 - d. 22 percent



T 99 / T 180 MOISTURE-DENSITY RELATIONS OF SOILS

7. Under which conditions is it necessary to prepare samples for each compaction point?
- a. For materials that degrade during compaction.
 - b. For clay materials that require an extended period for water to absorb to a uniform moisture content.
 - c. a & b
 - d. Always, due to the large required sample size for moisture content of granular materials.
 - e. None of the above.
8. Mass determination of compacted samples must be made to at least what degree of accuracy?
- a. 0.1 gram or 0.01 lb.
 - b. 5 grams or 0.05 lb.
 - c. 0.005 kg. or 0.01 lb.
 - d. All of the above.
 - e. None of the above.

9. When performing a T 99 Method B, fill the mold in _____ approximately equal layers and compact each layer with _____ blows of the rammer.
- 3 - - 25
 - 5 - - 25
 - 3 - - 56
 - 5 - - 56

Calculations

10. Calculation of Wet and Dry Density:

$$P_d = \left(\frac{P_w}{w + 100} \right) \times 100 \quad \text{or} \quad P_d = \left(\frac{P_w}{\frac{w}{100} + 1} \right)$$

P_w = Wet Density (lb/ft³)

P_d = Dry Density (lb/ft³)

w = Moisture Content (%)

Known:

1 pound = 453.6 g

Mold Factor (Select the correct one): 13.33 or 30

Mass of Moist Soil and Mold: 6593.1 g

Mass of Mold: 4366.4 g

Mass of Moist Soil: _____ g

Soil Moisture Content: 11.1%

For a sample compacted using **Method C**, the wet density is _____ lb/ft³.

The dry density is _____ lb/ft³.

The sieve size used during sample preparation is _____.

- 147.3 - - 132.6 - - 3/4 in.
- 128.3 - - 115.5 - - 3/4 in.
- 128.3 - - 115.5 - - No. 4
- 147.3 - - 132.6 - - No. 4
- None of the above.

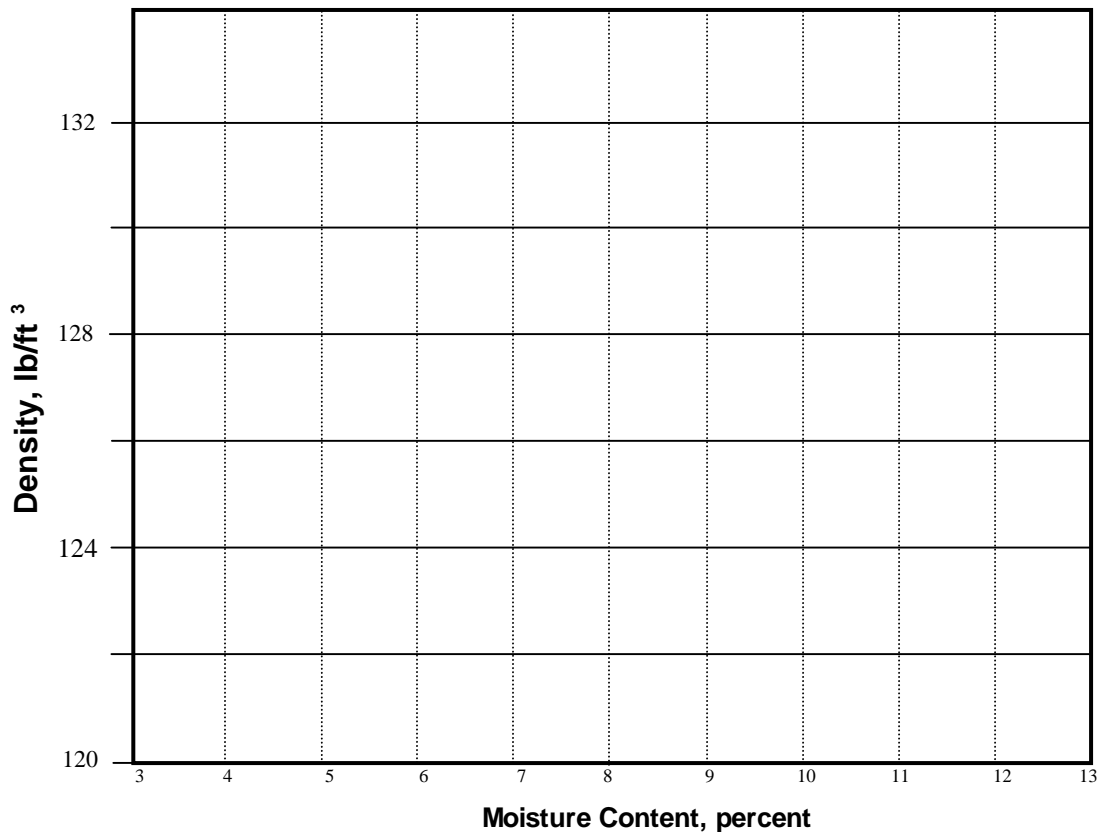
Calculations (Continued)

11. Plot the following dry density and corresponding moisture content values on the graph below.

Dry Density, lb/ft ³	Moisture Content, %
123.7	3.8
127.2	6.1
129.9	8.2
129.0	9.9
127.1	11.0

The approximate values for maximum dry density and optimum moisture are...

Density vs. Moisture Content



T 272 FAMILY OF CURVES – ONE-POINT METHOD

12. Describe the nature of curves with higher densities vs. those having lower densities.

13. According to this FOP, how does one decide whether the data from the one-point determination is valid for use in estimating a new maximum dry density and optimum moisture?

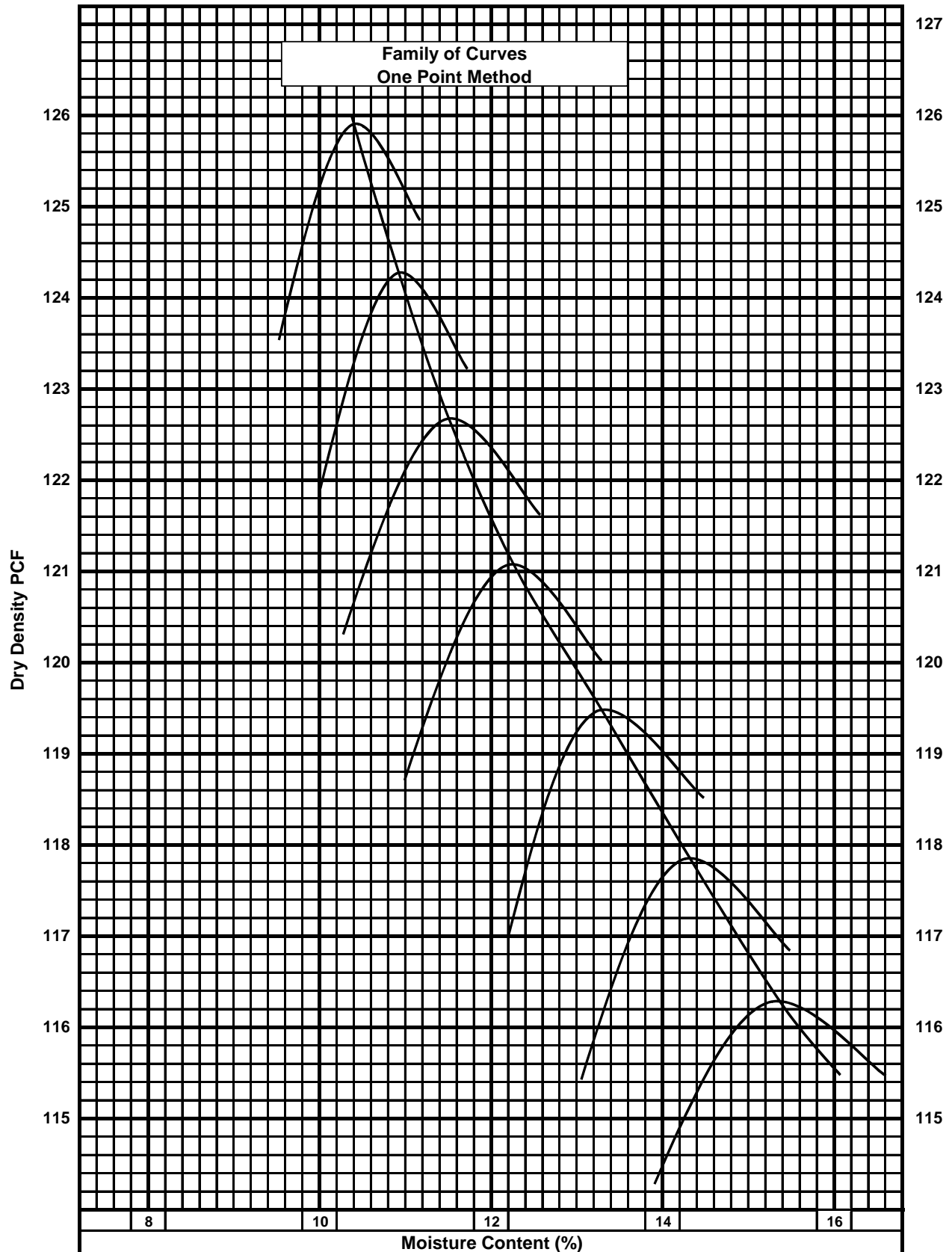
Calculations

14. Use the family of curves to determine maximum dry density and corresponding optimum moisture content.

Known: One-point determination = 125.4 lb/ft^3 @ 10.7%.

The estimated maximum dry density and optimum moisture content is _____. May this procedure be used given the one-point results? What must be done?

**** SEE GRAPH NEXT PAGE**



T 85 SPECIFIC GRAVITY AND ABSORPTION OF COARSE AGGREGATE**Calculations**

Perform calculations and determine the values requested using the appropriate formulas below.

Where:

$$\text{Bulk Specific Gravity (G}_{sb}\text{)} = \frac{A}{(B - C)}$$

$$\text{Bulk Specific Gravity (G}_{sb}\text{ SSD)} = \frac{B}{(B - C)}$$

$$\text{Apparent Specific Gravity (G}_{sa}\text{)} = \frac{A}{(A - C)}$$

$$\text{Absorption} = \frac{B - A}{A} \times 100$$

Sample	A Oven Dry Mass, g	B SSD Mass, g	C Weight in Water, g
1	2333.6	2346.2	1506.2

15. The reported G_{sb} is: _____

16. The reported $G_{sb}(\text{SSD})$ is: _____

17. The reported G_{sa} is: _____

18. The reported Absorption is: _____

Do the results make sense (Yes/No)? _____

If results do not make sense, why?

T 224 CORRECTION FOR COARSE PARTICLES IN THE SOIL COMPACTION TEST

19. This FOP is used to adjust the lab dry density and optimum moisture values determined when encountering coarse particles.

- a. True
- b. False

20. What particle sizes constitute coarse material? How is this related to the different methods of T-99 and T-180 (A, B, C & D)?

Calculations

21. Calculation of adjusted dry density and optimum moisture content.

Known:

Laboratory maximum dry density	D_f	= 131.1 lb/ft ³
Laboratory optimum moisture content	MC_f	= 8.4 %
Moisture content of coarse particles	MC_c	= 2.0%
Percent (oversize) coarse particles	P_c	= 20%
G_{sb} of coarse particles		= Use assumed value
Density of water		= 62.4 lb/ft ³
Density of (oversize) coarse particles	k	= $G_{sb} \times$ density of water

$$D_d = \frac{100 D_f k}{[(D_f)(P_c) + (k)(P_f)]}$$

$$MC_t = \frac{[(MC_f)(P_f) + (MC_c)(P_c)]}{100}$$

Using the information presented above, the adjusted values for maximum dry density and optimum moisture are...

T 89 DETERMINING THE LIQUID LIMIT OF SOILS

22. The moisture at the boundary between the plastic and solid states is known as the...
- Liquid Limit
 - Plastic Limit
 - Shrinkage Limit
 - Plasticity Index
 - None of the above.
23. Which of the following describes the number of “cuts” that may be used to divide the soil in the liquid limit cup?
- 1
 - 2
 - 4
 - 6
 - All of the above.

Calculations

24. Method B (Single Point)

N = blow count
 W_N = % moisture

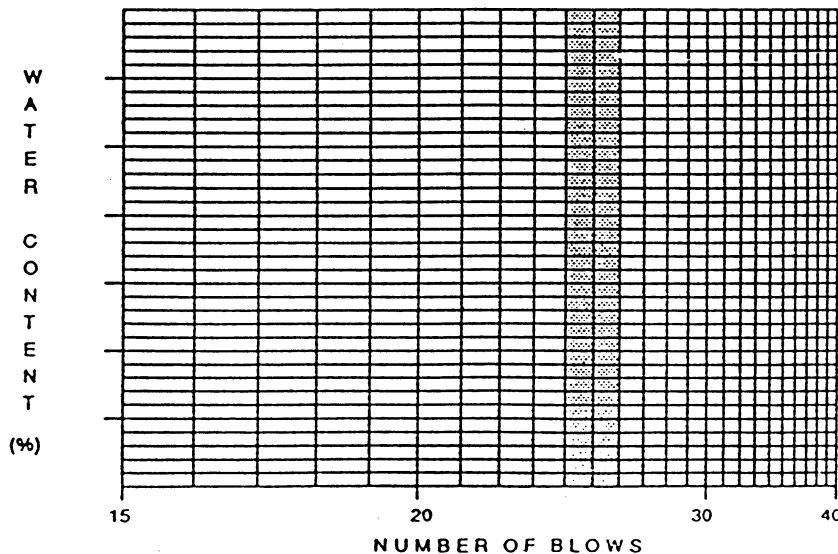
<u>N</u>	<u>$(N/25)^{0.121}$</u>	<u>N</u>	<u>$(N/25)^{0.121}$</u>
22	0.985	26	1.005
23	0.990	27	1.009
24	0.995	28	1.014
25	1.000		
$LL = (w_N)(N/25)^{0.121}$			

For this method of test, the reported Liquid Limit of a soil having a blow count of 28 corresponding to moisture content of 33.7% is:

25. Method A (Multi-Point)

Blows	Moisture Content, %
18	38.0
22	32.4
32	24.5

Using the liquid limit data presented above, plot the data on the graph provided and determine the Liquid Limit as reported.

**T 90 DETERMINING THE PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS**

26. When conducting the plastic limit test, how many grams of material must be obtained after mixing with water? How many grams of material are used for each individual determination?
- 20 -- 8
 - 20 -- 1.5
 - Approximately 8 -- 4
 - Approximately 8 -- 1.5 to 2
 - None of the above.

27. During the first rolling of the material, it is important that the entire sample achieve a thread diameter of 1/8 in. without crumbling. After successful completion of this step, which of the following must be done to complete the test?
- a. Break the thread into six or eight pieces and squeeze the pieces between thumbs and fingers into an ellipsoidal-shape mass.
 - b. Attempt to re-roll the sample into a uniform thread of 1/8 in. diameter.
 - c. Continue reforming the pieces and rolling until the thread crumbles exactly at the 1/8 in. diameter. If the sample crumbles at a diameter greater than 1/8 in. start the test over.
 - d. a & b
 - e. All of the above.
 - f. None of the above.

Calculations

28. Calculate the Plastic Limit for the container requested.

Container	Container Mass, g	Container and Wet Soil Mass, g	Container and Dry Soil Mass, g
1	14.67	25.65	24.47
2	14.32	24.69	23.62
3	14.19	19.83	19.34

The reported Plastic Limit for the soil in Container 2 is:

- a. 7.5
- b. 8
- c. 11.5
- d. 12
- e. None of the above.